Phase I Project Summary

Firm: Michigan Aerospace Corporation
Contract Number: NNX13CL11P
Project Title: RIDES: Raman Icing DEtection System

Identification and Significance of Innovation: Inflight icing of engines and airframe presents a significant hazard to air transport, especially at lower flight elevations during take-off or on approach. Ice accretions on the wings affect the smooth flow required for proper lift. A thin layer of coarse ice can reduce the lift by 30 percent and increase drag by up to 40 percent. In addition, accretions can also reduce the air intake in engines and affect readings from a (heated) Pitot tube. Michigan Aerospace Corporation proposes to continue the development of an integrated LIDAR instrument capable of identifying icing conditions while also allowing for air data sensing as well as other hazard detection capabilities. The resulting Raman Icing Detection System (RIDES), when coupled with MAC's optical air data solution, will provide unprecedented situational awareness and aircraft safety. The proposed solution will operate without protrusions into the flow, behind a common flush-mounted window on the skin of the aircraft, mitigating the risk of ice build-up during operation and therefore providing a critical redundancy through dissimilar measurement of air data parameters while greatly enhancing a pilot's awareness of potential icing hazards.

Technical Objectives and Work Plan: All objectives were achieved in this Phase I, including the determination of the operational envelope for RIDES and the resulting requirements, the trade studies and photon budgets using models to determine the design parameters of the instrument, and the design the full instrument for prototype fabrication and testing in Phase II.

Technical Accomplishments: Requirements have been established for both the intended flight envelope as well as the key parameters necessary to determine hazardous conditions. A photon budget has been calculated and the results are currently being verified in the lab through preliminary testing. The instrument design and the preliminary algorithms and methods to determine icing conditions are completed.

NASA Application(s): An airborne icing condition detection and characterization system, such as RIDES, will have wide applications in the study of the threat icing conditions pose to aircraft. In addition, the system will allow for climate change studies that look at aerosol concentration and distribution, including water vapor/liquid water content, in the atmosphere. There is potential to combine such a system with MAC's optical air data system and turbulence-detection systems into a unified system that would sense both icing conditions and turbulence hazards ahead and report airspeed along with air, temperature and density routinely.

Non-NASA Commercial Application(s): Outside NASA, military and civil aviation is often affected by icing, sometimes severely (e.g., Comair flight 3272 in 1997, Air France flight 447 in 2009) and the ability to detect these conditions so as to avoid or at least account for them (activating de-icing systems, etc.) would be of tremendous safety value, suggesting a substantial market. Michigan Aerospace Corporation is already working on a NASA project for clear-air turbulence (CAT) detection and volcanic ash detection ahead of an aircraft. Adding SLD to these optical air data system (OADS)-derived capabilities will lead to a powerful suite of optical instruments capable of measuring air data (air speed and direction along with air density and temperature) and warning of icing conditions, volcanic ash and clear-air turbulence, all without protruding into the flow around the aircraft and without ports or probes that can clog with debris or ice up.

Name and Address of Principal Investigator: Charles Richey, 1777 Highland Drive, Suite B, Ann Arbor, MI 48108-2285
Name and Address of Offeror: Michigan Aerospace Corporation, 1777 Highland Drive, Suite B, Ann Arbor, MI 48108-2285